FINAL REPORT NO. 3

Spectral Studies of Materials Possibly Present on the Martian Surface

Contract N 00014-67-C-0338

Research Project RR 004-06-01(NR 046-814)

OFFICE OF NAVAL RESEARCH

Washington, D. C. 20360

For the Period

February 1, 1967 - January 31, 1970

by

Arthur L. Draper
Joe A. Adamcik
Associate Professors of Chemistry
Department of Chemistry
Texas Tech University
Lubbock, Texas 79409

February 1, 1970

Spectral Studies of Materials Possibly

Present on the Martian Surface

The purpose of the work carried out in this study has been to develop a synthetic mixture congruous with the material on the surface of Mars, that is, a simulated Martian soil sample. In making mixtures for testing, we have, whenever possible, used chemically pure materials whose possible presence on the Martian surface is geochemically reasonable. To test whether the kinds and amounts of materials used in a mixture are satisfactory, the reflectance spectra of the various prepared mixtures are compared with the observed spectrum of Mars.

During the period covered by this final report, we have studied the sensitivity of the spectral match to the goethite-hematite ratio used in the sample. Goethite (α-$Fe_2O_3 \cdot H_2O$) and hematite (α-Fe_2O_3) are the iron minerals most likely to be responsible for the color of this planet (1). The purpose of this work was to set limits on the ratio for which a satisfactory spectral match might be obtained. We have begun by determining the best possible match obtainable using hematite alone on silica and adjusting the reflectance to approximate agreement with the Bond Albedo of the planet beyond 0.75 M. Figure I shows the reflectance of a mixture containing 15.8% hematite on quartz compared to the planetary data reported by Tull (2). It can be seen that the correspondence is good. Figure II shows a comparison of Tull's data with a material containing considerably less hematite than our previous samples. Again, the correspondence is good. This shows that the match is relatively insensitive to the quantity of iron oxide in the surface material.

At the time of this development in the study, the student working on the problem announced that he was leaving Texas Tech. Attempts were made to obtain a suitable replacement who would be capable in doing this somewhat specialized work. As our efforts were unavailing, this report describing the work completed

is being submitted and the unexpended funds are being returned.

References and Notes

1. Recently, W. T. Plummer and Robert K. Carson, Science, 166, 1141(1969) have proposed that the reddish color of Mars might be attributed to carbon suboxide polymers rather than to iron-bearing minerals. The suggestion is an intriguing one and further study to determine whether carbon suboxide can be formed and polymerized under Martian conditions is certainly warranted.

2. R. G. Tull, Icarus 5, 505 (1966).

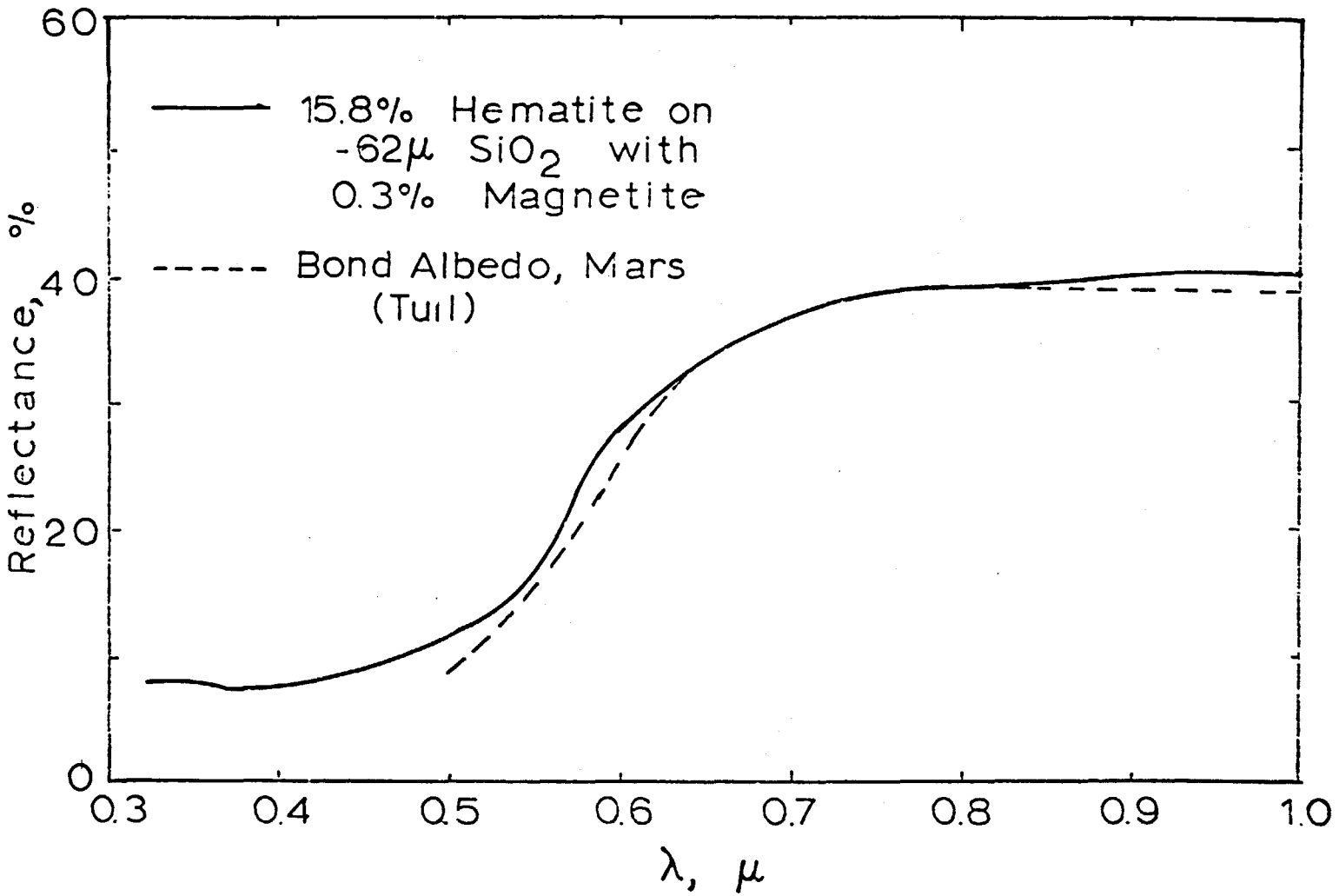
60
40
20
0
Reflectance, %
15.8% Hematite on
-62μ SiO2 with
0.3% Magnetite
Bond Albedo, Mars
(Tull)
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
λ, μ

Figure I

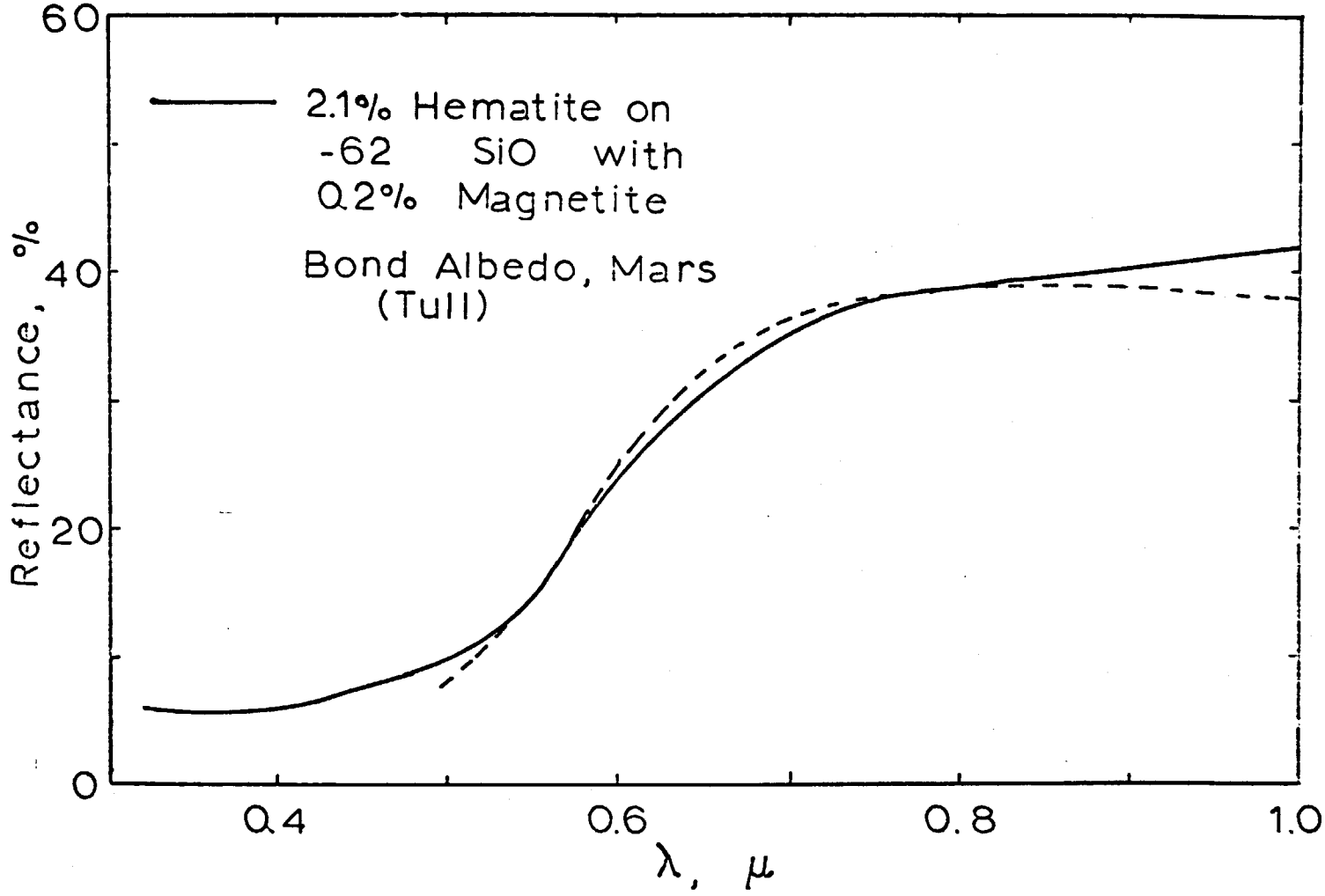
60
40
20
0
Reflectance, %
2.1% Hematite on
-62 SiO with
0.2% Magnetite
Bond Albedo, Mars
(Tull)
0.4
0.6
0.8
1.0
λ, μ

Figure II